Zwin Intertidal Study : September 2008

Intertidal ecology is the study of intertidal ecosystems, where organisms live between the low and high tide lines.

At low tide, the intertidal area is exposed whereas at high tide, the intertidal area is underwater. Intertidal ecologists therefore study the interactions between intertidal organisms and their environment, as well as between different species of intertidal organisms within a particular intertidal community.

Organisms living in this zone inhabit an ever-changing, hostile environment. Because of this, **they have evolved various adaptations to cope** with and even exploit these conditions. One easily visible feature of intertidal communities is **vertical zonation,** where the community is divided into distinct vertical bands of specific species going up the shore.

Species living in intertidal areas are required to cope with numerous abiotic and biotic factors affecting their survival. These are, for example: drying out (desiccation), competition for food and attachment sites, predation and tolerance to wave action.

Intertidal regions are utilized by humans for food and recreation, but anthropogenic (human caused) activities also have major impacts, with **overexploitation, invasive species and climate change** being among the problems faced by intertidal communities.

YOUR TASK

- You are required to independently design and carry out an investigation in an intertidal zone.
- You can choose a number of topics but you must design a lab that is an experimental investigation.
- Using the seashore guides, explore further information about the organisms that live in the zone to help guide your lab design. We have also given you additional sheets of information on the organisms listed below to help with your planning. Some possible organisms to study include:
    1. Seaweeds
    2. Periwinkles
    3. Limpets
    4. Barnacles
    5. Mussels

As with any planning lab, you need to satisfy the IB requirements (see rubrics below). A clear research question is a must along with a clear materials list and a procedure which clearly states which variables are being measured and how variables are being controlled.

Data may be collected using numerous types of equipment such as quadrats, sighting poles, tape measures, etc.

Intertidal Lab – Mussels

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Research question:

Is there a relationship between the length of a mussel and its distance in meters from the shore?

Hypothesis:

As the mussel gets closer to the shore, its size will decrease. This is because near the shore, the organisms will be more exposed to the sun and less exposed to waves and water in general. Mussels are organism which rely on water for their nutrition as a result of being 'filter-feeders'- feeding on organisms which free-float on sea water. The mussels further away from the shore will be under water for longer periods of time, a factor which will increase their nutrition. Moreover, mussels which are closer to the shore and are less time submersed in the water will be more exposed to bird predation as well as the sun, which can cause their desiccation. All in all, mussels which are closer to the shore will have less food sources, will be more exposed to predation and the sun, leading them to be smaller than mussels which are further away from the shore and are submersed in water for longer periods of time.

Variables

Independent variable: distance in meters from the shore

Dependent variable: length of the mussel in cm

Control:

- Wave breaker in the North Sea of Belgian coast
- Way of selecting mussels across the wave breaker – (randomly choosing 25 across the wave breaker at each 10 meters up to 150 meters)
- Area of observation – at each pole, the wave-breaker was observed as the researcher walked across it from north to south
- Classification of mussel sizes
  - Size classification:

Small:

0 – 2.5 cm

→ mussel of size classification: small

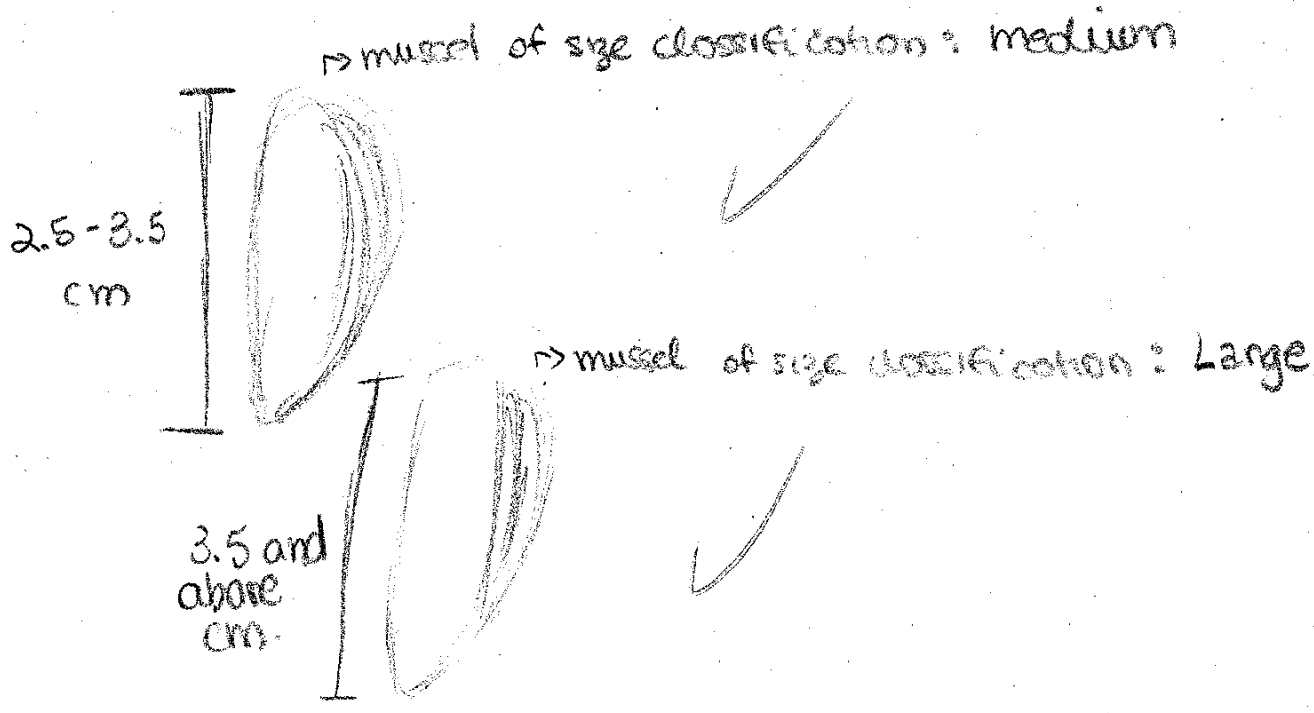
0-2.5 cm

Medium:

2.5 – 3.5 cm

Large:

3.5 cm and above



Materials:

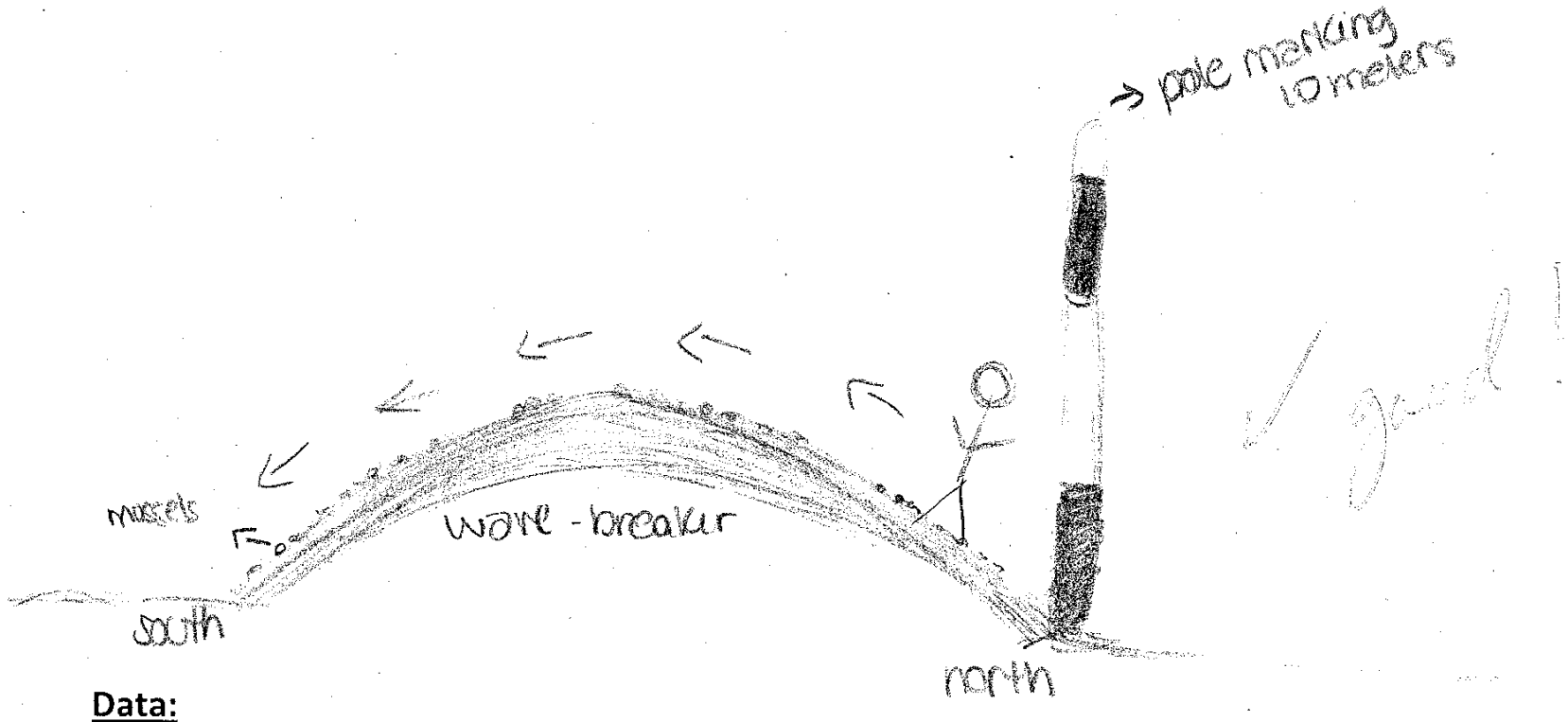
- Ruler
- Measuring tape
- 15 Poles

Procedure:

1. Estimate the size classification of mussels; in this case, for a mussel to be considered small its length has to be up to 2.5cm. For it to be medium sized, its length has to be from 2.5 to 3.5, and for it to be considered large its length has to be at least 3.5 cm.
2. Using the measuring tape, measure 10 meters from the shore. When reaching 10 meters, place a pole at the position, as can be seen in Figure 1.
3. Measure more 10 meters, and then position a second pole to mark the location which is 20 meters away from the shore. Do this until 150 meters are reached.
4. At the 10 meters pole, walk across the wave breaker from north to south as seen in Figure 2. While walking across; randomly select 25 different mussels which can be found. When randomly picking, it needs to be assured that the mussels are from different positions along the wave breaker, so that around 12 have to have been selected until you reach the center, and then other 13 mussels have to be selected until you finish walking across the wave-breaker.
5. Count the individual mussels and classify them according to their size classification. Record the data.
6. Repeat the fourth and fifth step for every 10 meters, up to 150 meters.

Figure 1: Pole positioning

Figure 2: Walking across north to south in order to select the mussels

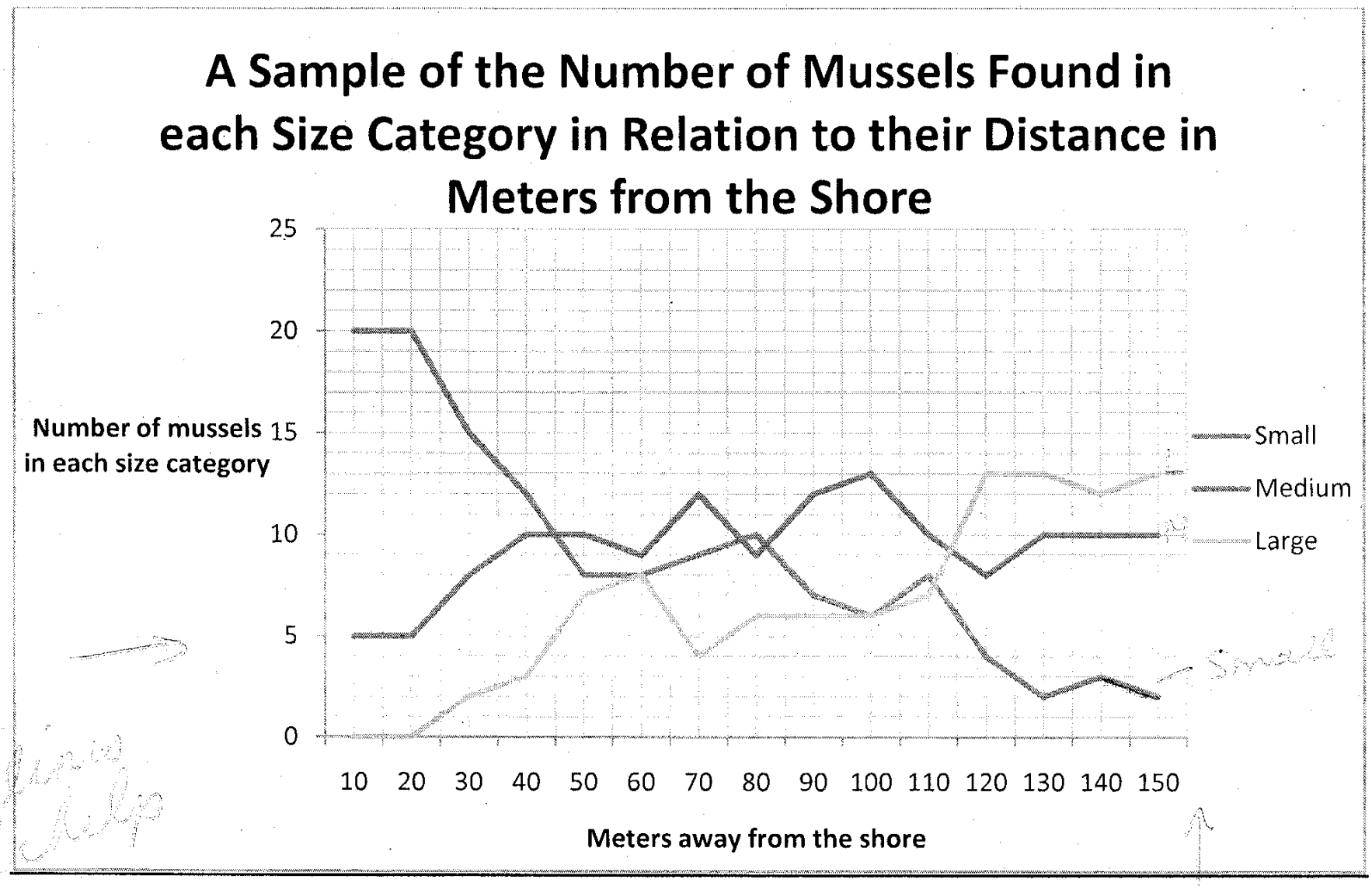


Data:

Table 1: The classification sizes for the mussels found every 10 meters away from the shore

	Mussel																								
Distance from the shore (m)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
10	M	S	M	M	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	M
20	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	M	M	M	S	S	M	S	S
30	S	S	S	S	S	S	S	S	S	S	M	M	M	L	M	L	M	M	M	M	S	S	S	S	S
40	S	S	S	S	S	S	S	S	S	S	S	M	M	M	M	M	L	L	M	M	M	L	M	S	M
50	M	M	M	S	S	S	S	S	M	M	L	L	L	L	L	L	M	M	S	M	S	M	M	S	L
60	S	S	S	S	S	S	M	M	L	L	L	M	L	S	S	M	L	M	M	M	M	L	L	L	M
70	L	L	M	S	S	S	S	S	M	M	M	L	L	M	M	M	S	S	S	M	M	M	M	S	S
80	S	S	L	L	L	M	L	M	M	S	S	M	M	S	S	S	M	L	S	M	L	M	S	S	M
90	S	S	S	M	M	M	L	L	L	L	M	M	S	L	M	S	L	M	M	M	M	M	M	S	S
100	L	L	M	S	S	M	M	M	M	L	M	M	M	M	S	L	L	M	S	M	L	S	M	S	M
110	S	S	M	M	L	L	L	M	S	S	S	S	L	L	M	M	M	M	L	L	S	S	M	M	M
120	M	M	S	S	L	L	M	M	M	L	L	L	M	L	L	L	L	L	L	L	M	M	S	S	L
130	L	L	L	M	L	L	M	S	S	L	L	M	L	L	M	M	M	L	L	M	M	M	M	L	L
140	L	L	L	L	L	L	M	M	M	L	L	L	M	M	M	M	L	L	S	S	S	M	L	M	M
150	L	L	L	L	L	L	L	L	L	L	M	M	M	M	M	S	S	L	L	L	M	M	M	M	M

Graph 1:



Discussion

The data collected in this experiment supports the hypothesis that the length of the mussels increases as their position in relation to the shore increases. According to the graph, as distance from the shore increases, there will be more mussels with a size classification of large and less mussels with a size classification of small. At a distance of 10 meters from the shore, there were about 20, out of the 25 mussels randomly selected, which were classified as small. Meanwhile there were 0 mussels found in that position with a size classification of large. At 50 meters away shore, there is a significant change concerning the data. The number of mussels found with a size classification of small decreased to 8 while the number of mussels which are considered large increased to 7. At the final position of 150 meters away from the shore, the difference is even greater as there appear to be 13 mussels classified as large and only 2 classified as small. The changes which occurred as the distance from the shore increased support the hypothesis that as the distance from the shore increased, the size of the mussels also increased.

Many factors concerning the environment at the shore also support the results acquired as well as the hypothesis. Mussels are organisms which rely on water for their nutrition. They are 'filter-feeders', meaning that they feed on sea creatures which are free-floating in the seawater such as plankton and other sea creatures. So, the greater their distance from the shore, the more food resources will be available for their survival as they will be longer periods of time under water.

Moreover, with the greater exposure to water as a result of an increase of the distance from the shore, the mussels will be less exposed to the sun as well. Mussels' mortality can be associated with their tolerance concerning temperature and desiccation. So, if they are exposed to a high temperature and sunlight they are more likely to have a shorter life spam due to desiccation stress. The longer period of time that they are under water, the smaller will be the impact of sun and temperature on them, influencing once again their sizes. When under water, mussels are also less exposed to predators such as birds. All these factors contribute to their size, so that as the distance from the shore increases, their size should also increase, supporting the data acquired for the experiment.

Evaluation

Although the results acquired coincided with facts in relation to mussels and their sizes, sources of error in relation to this experiment also exist. First of all, the mussels were picked randomly, so that there could have been in total the same number of small and large mussels but if only the large mussels were selected, the data would not be very representative of the actual situation. Therefore, picking mussels randomly is a source of error as 25 is a very small number considering all the mussels which were present in the wave-breaker. Another aspect which must not be forgotten is the fact that the wave-breaker is not flat but actually more elevated on its center, so that its sides would be more affected by the water action than its center. This aspect would lead to a difference in the size of the mussels as well since some would be more exposed to the water while others would not, causing size variation within the same distance from the shore.

Abiotic factors need to be taken into consideration when evaluating this experiment. The mussels' different exposure to sunlight, temperature and wave action also affects their sizes. The mussels on the sides of the wave breaker were more exposed to the wave actions, which would lead them to be relatively small as a result of the pressure caused by the waves. Also, the mussels at the center of the wave-breaker are more exposed to sunlight and higher temperatures. This factor could also influence the sizes of the mussels in the center in relation to mussels on the sides of the wave-breaker independently of their position concerning the shore. Due to the greater exposure, the mussels in the center would be smaller than the mussels which were less exposed to factors such as the sun and temperature, affecting the data of the experiment.

Conclusion

The data of this experiment supports a relationship between the length of a mussel and its distance in meters from the shore. As the distance from the shore increased, the number of mussels with a size classification of large increased while the number of mussels with a size classification of small decreased. Although the data supported the initial hypothesis, there were many sources of error to this experiment such as abiotic factors influence, the collection method, and the structure of the wave-breaker. An area of improvement for this experiment would be to only select mussels which have the same position along the shore, so that they are all only on the north side, only on the center of the shore, or only on the south side. Then, all the mussels selected at each position would have been exposed to the same characteristics concerning wave action, water, sun, and predation; turning results for the experiment more accurate and reliable.